Breast Reconstruction in Private Practice

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ABSTRACT

Comprehensive breast reconstruction can be performed in private practice. Our practice philosophy is that autogenous tissue provides the best substrate for breast reconstruction; the deep inferior epigastric perforator flap is our primary method of breast reconstruction. Microsurgical training and a group practice model permit routine use of all autogenous tissue techniques. Office, operating room, and hospital teams must be assembled; these teams follow clinical pathways, which make the execution of reconstructive procedures consistent and efficient. The practice must implement a plan for physician and patient education. The practice must review clinical outcomes, making adjustments in operative techniques and pre- and postoperative clinical pathways so that the best results can be achieved with a low complication rate. Breast reconstruction is a core service of our practice. We have accrued an economy of scale including these features: intraoperative and clinical efficiency, low practice overhead costs, and a high patient satisfaction rate.

KEYWORDS: Autogenous tissue, clinical pathways, efficiency

Breast reconstruction—in which the full spectrum of reconstructive techniques is available—can be successfully performed in a private practice setting. To accomplish this in an efficient, cost-effective manner and to achieve quality outcomes, several criteria must be met. Breast reconstruction in the private practice setting is ideally performed by two or more surgeons who are well trained in reconstructive surgery in general and in breast reconstruction specifically. All members of the group require training in microsurgery, obtained through a plastic surgery residency, microsurgical fellowship, or both. The surgeons must feel comfortable performing microsurgery on a routine basis; they must be proficient at it as well.

A group practice facilitates many aspects of breast reconstruction: efficient processing of patient referrals; intraoperative efficiency via a team approach; easy access to a second opinion in difficult cases; sharing of flap monitoring and general call responsibilities; and timely operative scheduling, which is of great importance to the referring surgical and medical oncologists as well as to

the patient who is anxious to initiate treatment. Breast reconstruction should be a core service of the practice. The group must adopt a philosophy about reconstruction, coming to a general agreement about the preferred primary method of reconstruction, timing of reconstruction, and postoperative care (Fig. 1).¹⁻⁵ Breast cancer patient care requires a comprehensive knowledge of reconstructive techniques; surgical judgment and skill, and time, energy, and compassion on the part of the surgeons and the entire office staff.⁶ In our view it is difficult to dabble in breast reconstruction. The ultimate goal for the breast reconstruction practice is reproducibly high-quality outcomes from all methods of reconstruction.

ESTABLISHING BREAST RECONSTRUCTION IN PRIVATE PRACTICE

Establishing a practice in breast reconstruction takes place at a “grassroots” level. All surgeon members of the practice must develop and maintain strong working relationships with the other physicians involved in breast

A New Decade in Breast Reconstruction; Editor in Chief, Saleh M. Shenaq, M.D.; Guest Editors, Geoffrey L. Robb, M.D., F.A.C.S. and Michael J. Miller, M.D., F.A.C.S. *Seminars in Plastic Surgery*, Volume 18, Number 2, 2004. Address for correspondence and reprint requests: Steven M. Pisano, M.D., Plastic, Reconstructive, and Microsurgical Associates of South Texas, P.A., 4499 Medical Drive, Suite 311, San Antonio, TX 78229.
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Figure 1 A 33-year-old woman 2 years after immediate right breast reconstruction with a muscle-sparing free TRAM flap and left breast mastopexy.

cancer care, especially surgical oncologists and general surgeons (the most frequent referral source in our practice), medical oncologists, and radiation oncologists. These specialists, along with family and general practitioners, gynecologists, and internists, should be informed about breast reconstruction options and, indeed, that breast reconstruction is an option at all.^{7,8} Educating the various specialists can be accomplished in a variety of ways: attendance at weekly or monthly breast cancer conferences or tumor boards; presentations to local physicians and breast cancer support groups; participation in breast cancer organizations that assist un- or under-insured patients; and by individual visits with physicians involved in the diagnosis and treatment of breast cancer.

Just as the surgeon members of the group must develop good relationships with other physicians, so too must the members of the practice staff develop good relationships with the staffs of the referring physicians, especially those of the general surgeon or surgical oncologist. This is a necessity if immediate breast reconstructions are to be performed. In our practice, for example, one of the members of the group routinely first assists the surgeon performing the mastectomy; upon completion of the mastectomy, the general surgeon departs and the second member of the reconstructive team arrives to perform the reconstruction. Our scheduling personnel work with the staff of the general surgeon to get an early start so that the reconstruction can begin while the plastic surgical team is fresh.

MAINTENANCE OF BREAST RECONSTRUCTION IN PRIVATE PRACTICE

Maintaining breast reconstruction in the private practice setting is an ongoing process. Best practices and clinical pathways must be developed and then reevaluated; the practice should continue to look for ways to improve pre-, intra-, and postoperative efficiency; minimize com-

plications; and improve the overall patient experience during the reconstructive process.⁹

In contrast to many academic practice settings in which the consequences of a flap loss are significant but not entirely unexpected (e.g., secondary and tertiary cases, cases involving chest wall damage secondary to radiation therapy, patient care delivered at a teaching institution), in a private practice setting the consequences of a flap loss, even a partial flap loss, may be far-reaching in terms of patient satisfaction, referral patterns, and the surgeon's standing in the community. A certain percentage of flap loss may be inevitable; however, the practice should adopt a conservative approach to patient selection in an effort to minimize the risk of flap loss and other complications.¹⁰ As the practice matures, consideration may be given to broadening the patient selection process to include more challenging circumstances and to performing more challenging methods of reconstruction.¹¹⁻¹⁶

ESSENTIAL COMPONENTS OF A BREAST RECONSTRUCTION PRACTICE

Surgical Team

Although breast reconstruction may be part of a solo practice, the group practice model offers several advantages. Using a team approach intraoperatively, flap harvest and exploration and dissection of the recipient vessels can be performed simultaneously. Two surgeons can work under the microscope to prepare the vessels and execute the anastomosis. Closure of the donor site and shaping and inset of the flap can then be performed simultaneously. Microsurgical training affords maximum flexibility and time efficiency. In our practice there is a general division of labor for autologous tissue methods of reconstruction, whether by free tissue transfer or pedicled technique; the surgeon performs the same steps each time (although each member of the group can perform all aspects of the reconstruction). Members of the group must work in cooperative, collegial fashion. Breast reconstruction is mentally and physically challenging for the surgeons and patient; the expectations are high.

Intraoperative Team

To execute breast reconstruction efficiently an adequate number of well-trained, skillful, and highly motivated operating room personnel are needed. The circulating nurse and surgical technicians must be able to consistently assemble the necessary equipment for both autologous tissue and tissue expander implant procedures. Use of two surgical technicians permits a two-team approach, streamlining simultaneous flap harvest and recipient vessel preparation, and after the microsurgical

portion of the procedure, simultaneous flap inseting and donor site closure.

Postoperative Nursing Team

Postoperative care is accomplished with a well-orchestrated team approach, employing standard orders and clinical pathways. We emphasize fluid management, control of blood pressure, incentive spirometry, and early mobilization.

Patients undergoing free flap breast reconstruction are monitored first in the surgical postanesthesia recovery room and then in a surgical floor setting. Recovery room and floor nurses have been trained to monitor free transverse rectus abdominus (TRAM), free deep inferior epigastric perforator (DIEP), and other perforator flaps, as well as pedicled flaps. Flap assessment training is accomplished by "in-service" classes conducted by one of the surgeons of the group or nurses experienced in flap monitoring, a customized educational video produced by our group, and by direct bedside teaching by senior nurses to younger nurses or nurses inexperienced in flap assessment. This pool of nurses with flap assessment capabilities constitutes a flap unit "without walls." Because of the large volume of breast reconstruction patients in our practice it is necessary to have multiple surgical units with adequately trained nursing personnel who can accept and properly care for flap reconstruction patients. Surgeons who routinely perform free tissue flap breast reconstruction may elect to develop a dedicated physical space with a core of experienced nurses trained in flap assessment—a formal flap unit.

Nurses assess the flap for skin paddle color, subjective surface temperature, and capillary refill. Arterial and/or venous signals are confirmed with a pencil Doppler probe. With proper training and experience the nurses are able to recognize key problems: occlusion of arterial inflow or venous outflow and flap or donor site hematoma. Floor nurses assess the flap every hour during the first 24 hours, every 2 hours from 24 to 48 hours, every 3 hours from 48 to 72 hours, and thereafter every 4 hours. If a problem with the flap is suspected nursing staff immediately notify one of the surgeon members of the group, who will then promptly evaluate the flap.

Practice Nursing and Administrative Team

The practice nursing staff is one of the most important components of the reconstructive team. In our practice the nurses develop a strong rapport with breast cancer patients. They are frequently called upon to answer questions and give reassurance. Practice nurses are trained to recognize problems with both flap and tissue expander implant reconstructions. In addition, they are trained to assess chest wall and donor site areas for problems:

dehiscence, infection, epidermolysis, seroma, and abscess. Practice nurses are capable of performing local wound care, including minor wound debridement.

Patients are seen weekly for the first 3 to 4 weeks; the two or three visits are usually exclusively with one of the practice nurses. During this time drains and sutures are removed. The nursing staff gives instructions about incision care, activity level, and diet, and advises the surgeon about the return to work status of the patient.

The administrative members of the practice (practice administrator, billing personnel, and patient care coordinator) strive to guide the patient through the nonmedical but frequently stressful aspects of breast reconstruction: working with payors, arranging time off from work for patient and family, and coordinating the approval and scheduling of subsequent procedures.

PHYSICIAN EDUCATION

The group must dedicate itself to educating the various specialists involved in the diagnosis and treatment of breast cancer. Surgeons and oncologists should have a working knowledge of the advantages and disadvantages of autologous and tissue expander implant methods of reconstruction. They should be aware that in most cases breast reconstruction can be performed immediately; myths about the routine need for blood transfusions, long operative times, prolonged recovery periods, and high complication rates must be dispelled. For example, in our practice the typical operative time for a unilateral free TRAM or DIEP flap is 2.5 to 3 hours; the hospital stay is 3 to 4 days; the recovery time is 3 to 4 weeks. The oncologist must be informed that, barring a major complication, an immediate reconstruction does not delay chemotherapy.¹⁷ Furthermore, an immediate reconstruction using a skin-sparing mastectomy does not increase the incidence of a local recurrence.¹⁸

Awareness of these and other aspects of breast reconstruction will vary with practice locality and the general educational level of the physicians in the community.¹⁹ Despite advances in reconstructive techniques, breast reconstruction is an underutilized component of breast cancer therapy nationally.²⁰ The practice must be persistent in its efforts to educate physicians, and the community at large, about breast reconstruction. State-of-the-art breast reconstruction is accomplished when referring and other involved physicians are well informed about breast reconstruction options, and perhaps more importantly, confident in the surgical skill and judgment of the reconstructive surgeons.²¹

PATIENT EDUCATION

Like physician education, patient education is a necessary and challenging process, involving the reconstructive surgeons, practice administrator, nurses, patient care

coordinator (if the practice has one), scheduling personnel, and billing and collections personnel. In our practice, the process begins with the first visit; patients watch an educational video outlining the basic methods of breast reconstruction, duration of hospital stay, expected length of time of recovery, schedule of follow-up visits, timing of secondary procedures, and potential complications. Patients are given a packet of information containing pre- and postoperative care instructions. They then meet one of the surgeons who will oversee their reconstruction. Usually, a method of reconstruction is determined during the initial visit; occasionally, a second visit

is required to decide upon a reconstruction method. Patients meet at least one of the practice nurses, and preoperative teaching points are made. In addition, they meet with our patient care coordinator (a breast cancer survivor who underwent free TRAM flap breast reconstruction) so that they can learn firsthand what to expect following breast reconstruction. Near to the time of surgery, within 3 to 5 days typically, the patients return for a second preoperative visit. The indications, risks, and benefits of the procedure are reviewed; preoperative instructions are given; prescriptions are issued; and the in-office consent is signed.

Figure 2 A 51-year-old woman 1 year after immediate right breast reconstruction with a muscle-sparing free TRAM flap and right breast mastopexy. (A, B, C) Preoperative views. (D, E, F) Postoperative views.

Patient education continues in the postoperative period. Surgeons, nurses, and the patient care coordinator must reinform and reassure the patient about various aspects of the recovery process.

PATIENT SELECTION

In our practice patients range in age from young to old (28 to 76) and in body types ranging from thin to obese

(body mass index 18 to 40). Approximately 66% of our patients are obese or morbidly obese.²² We have performed breast reconstruction in primary (Fig. 2), secondary (after a previous failed reconstruction), and tertiary (after multiple failed reconstructions) settings; in smokers; in patients with significant past medical (typically diabetes) and surgical (previous abdominal procedures) histories (Fig. 3); following breast and/or chest wall radiation (Fig. 4); and even following kidney and

Figure 3 A 46-year-old woman with a failed tissue expander implant 5 months after delayed left breast reconstruction with a muscle-sparing free TRAM flap and right breast mastopexy. (A, B) Preoperative views. (C) Preoperative view of abdominal wall; patient has a history of multiple surgical procedures. (D, E) Postoperative views.

Figure 4 A 38-year-old woman 6 months after delayed left breast reconstruction with a muscle-sparing free TRAM flap. (A, B) Preoperative views; note the radiation dermatitis of the left and central chest wall areas. (C, D) Postoperative views.

heart transplant surgery.²³ Autologous tissue is preferred for breast reconstruction, although tissue expander implant reconstructions are performed in patients who are not candidates for a flap reconstruction, who do not wish to risk donor site morbidity, or who choose this option over the various flap options.²⁴

We consider the microvascular free muscle-sparing TRAM flap and, more recently, the DIEP flap, to be the gold standards for breast reconstruction (Fig. 5).^{25–28} These autologous tissue methods are preferred because they offer superior aesthetic results; a soft, warm, natural-feeling reconstructed breast; the ability to achieve symmetry with the opposite native breast; a potentially sensate reconstructed breast, with the addition of a microneurorrhaphy; and a “durable” result, one that is maintained, or even one that improves, over time.

The microvascular free TRAM or DIEP flap offers flexibility in breast reconstruction; these techniques can be used for primary and secondary (to salvage a failed implant or other non-TRAM or DIEP flap procedure) reconstructions, in cases in which the chest wall has been irradiated, and in circumstances in which the residual native breast skin-chest wall envelope is exceedingly thin (Fig. 6) or absent following extensive tissue resection (Fig. 7). Use of the free TRAM or DIEP flap allows one

to avoid the pitfalls of tissue expander implant reconstructions: infection, malposition, contracture, deflation, and infection.²⁹ Implant reconstruction patients often require multiple procedures aimed at maintaining the breast mound; long-term resource costs associated with a tissue expander implant reconstruction may be higher, depending on practice location and surgeon experience and preference, than those associated with a free TRAM flap reconstruction.^{30–32} The free TRAM or DIEP flap also offers the potential advantage of an improvement in the contour of the abdominal wall: elimination of soft tissue excess, correction of lower abdominal musculo-fascial laxity, and repair of epigastric rectus diastasis. Contour abnormalities, however, may result.^{33–37}

Though we consider the free DIEP, or muscle-sparing free TRAM, flap to be the best options for breast reconstruction, we recognize its disadvantages: need for microsurgical training, overall complexity, multiple surgical sites, partial or complete flap loss, donor site complications, mental and physical demands for the surgeons, and declining reimbursement. These factors contribute to the underutilization of the free TRAM or DIEP flap in the private practice setting. However, identification of the factors contributing to the underutilization of these and other flaps allows for design and

Figure 5 A 51-year-old woman 9 months after bilateral breast reconstruction with free DIEP flaps. (A, B) Preoperative views. (C, D) Postoperative views; the patient is 1 month status post-nipple-areola reconstruction.

implementation of surgical and clinical pathways that increase efficiency and improve clinical outcomes.

The practice must develop a philosophy regarding patient selection and preferred methods of breast reconstruction. Again, we would urge reconstructive surgeons in private practice to adopt a conservative bias, perhaps starting with more straightforward cases and progressing to more difficult ones as the practice gains efficiency and experience. The methods most commonly employed will depend, along with the above-mentioned factors, on the local payor mix and the general level of reimbursement for flap procedures. The practice must be able to determine its cost basis for all methods of breast reconstruction; it must define what is tenable reimbursement. It is helpful to have an office administrator who can calculate the overhead costs of the various methods of breast reconstruction employed by the practice. Furthermore, the administrator should build relationships with the appropriate representatives of contracted payors. If the practice can demonstrate efficiency and consistently favorable outcomes, it may be possible to negotiate reimbursements for breast reconstruction procedures. Knowing the cost basis of each reconstructive procedure also allows us to negotiate fair and equitable reimbursement rates for under- and uninsured patients.

BREAST RECONSTRUCTION METHODS

Operating Room Requirements

Successful breast reconstruction depends heavily on an operating room with well-trained, motivated personnel and well-maintained, high-quality equipment. A high priority is placed on assembling surgical technicians and circulating nurses who can perform all methods of breast reconstruction and, especially in our practice, microsurgical flap procedures. Ideally, as the same relatively few personnel participate in flap reconstructions, skill and efficiency improve. Similarly, assembling a small core group of anesthesiologists who are willing and able to perform special tasks during the procedure is helpful. Key functions include: establishing and maintaining dense muscle paralysis to permit rapid, safe flap harvest; maintaining adequate hydration to avoid vasospasm; controlling blood pressure; keeping the patient warm; extubating the patient smoothly and painlessly; and preventing nausea and vomiting.

Operative Techniques: Microvascular Flaps

The precise boundaries of the breast are marked preoperatively with the patient in a sitting position,

Figure 6 (A–D) A 65-year-old woman 5 months after bilateral capsulectomy-implant removal with bilateral free DIEP flap reconstruction. The patient presented with capsular pain and contracture; she underwent bilateral subcutaneous mastectomies, through a Wise reduction pattern, followed by multiple implant reconstructions. Note the thin soft tissue envelope.

highlighting the inframammary fold and medial, lateral, and superior extent of the breast parenchyma. Typically, a skin-sparing mastectomy pattern is marked (Fig. 8), except in cases in which the tumor is located close to the skin, resulting in a larger native skin–soft tissue defect. For patients with grade one to grade two ptosis a vertical reduction pattern is often used. For grade three ptosis a Wise pattern is considered; however, if this pattern is used care must be taken to keep the native breast skin flaps thick or tissue necrosis will occur in the triangular areas of the skin flap.

One of the members of our group usually assists the surgeon performing the mastectomy. The surgeon is

encouraged to respect the boundaries of the breast, especially the inframammary fold, and to keep the skin flaps thick enough to preserve perfusion. Following the mastectomy, in cases of free TRAM or DIEP flap reconstruction, flap harvest and exploration and dissection of the recipient vessels proceed simultaneously.

We prefer to use the internal mammary vessels to provide inflow to the flap.³⁸ Once the exposure technique is mastered, these vessels are readily accessible, provide strong arterial inflow, and permit rapid positioning of the flap and a comfortable working position under the microscope. A potential disadvantage is that the left internal mammary vein, or veins, can be thin-walled

Figure 7 A patient with a left malignant phyllodes tumor who underwent a mastectomy, including a large portion of breast and chest wall skin, followed by immediate reconstruction with a muscle-sparing free TRAM flap. (A, B) Preoperative views. (C, D) Postoperative views.

and of small caliber (1 to 1.5 mm), making the venous anastomosis difficult; venous outflow obstruction may occur.^{39–41} Despite this caveat, in our experience the left internal mammary vein can safely be used for venous outflow in the vast majority of cases. The right internal mammary vein is routinely of adequate caliber (2 to 3 mm). Recently, we have used the second intercostal perforator vessels, if they have been left intact during the mastectomy and if they are of good caliber. Use of this recipient pedicle obviates the need for excision of a segment of costochondral cartilage, which saves time and reduces parasternal soreness. Other recipient vessels with which we have experience include the thoracodorsal, circumflex scapular, serratus anterior, and descending (pectoral) branch of the thoracoacromial trunk.⁴²

The TRAM or DIEP flap is marked prior to prepping and draping of the patient so that the entire trunk is in full view. Previous abdominal surgery is common in our patient population; right subcostal, Pfannenstiel, and lower abdominal midline are frequently encountered, singly or in combination. These incisions do not preclude the TRAM/DIEP flap. Careful preoperative assessment with the patient in the standing and sitting position, appropriate placement of the flap, and intraoperative decision-making regarding flap viability are required. We have not found it helpful to routinely obtain preoperative duplex Doppler imaging, although this modality can be used if the surgeon wishes to get an idea of the number and location of flap perforators.⁴³

To minimize abdominal wall morbidity, a muscle-sparing TRAM or DIEP flap is harvested. For the

Figure 8 (A) Preoperative and (B) 2-year postoperative views of a 38-year-old patient with left breast ductal carcinoma in situ (DCIS); the preoperative view shows the breast boundaries and skin-sparing pattern; the postoperative result shows the reconstruction with a free TRAM flap.

muscle-sparing TRAM flap, inflow to the subcutaneous tissues is based on two to four perforators, taken from the medial and lateral row.⁴⁴ The DIEP flap is based on one to two perforators and contains little or no intervening rectus muscle; in our experience the midlevel or upper medial perforator includes a large draining vein, ranging from 2.0 to 2.5 mm in diameter. We will not harvest the flap as a perforator flap unless a large draining vein is present. An effort is made to preserve motor intercostals nerve branches; however, some motor nerve branches, for example those located between perforators and over the epigastric pedicle, may require cutting to extricate the flap from its bed.

The surgeon must be familiar with the anatomic variations of the epigastric pedicle and its perforators.⁴⁵ For the DIEP and other perforator flaps, a wide range of perforator size and intra-muscular anatomy exists.⁴⁶ We urge caution in attempting to dissect flaps based on only one, or even two, perforators. Venous congestion may occur; partial or complete flap loss may result.⁴⁷ In our experience, the inclusion of a small cuff of rectus muscle, or even a rectangular block spanning the middle one third of rectus width, to permit the inclusion of two to three perforators, will minimize the incidence of fat necrosis and will have little impact on abdominal wall strength and overall recovery.⁴⁸

Once the flap has been harvested and the recipient vessels dissected, the patient is given an intravenous heparin bolus ranging from 25 to 30 units/kg (typically 1800 to 2000 units). After several minutes the flap is brought to the chest wall. Under microscopic magnification the epigastric and internal mammary (or other) vessels are prepared for anastomosis: the vessels are cut

to the appropriate length, trimmed of excess adventitia, dilated, and irrigated with a heparin-saline solution (25,000 units of heparin in 1 L of Ringer's lactate) via a pressurized jet irrigation system (the heparin solution is placed in a Cabot pressure pump; the solution is delivered by an Infinity Irrigator Set, manufactured by Infinity Surgical Technology, Inc., Mequon, WI, fitted with a 27-gauge anterior eye chamber needle). We routinely perform the arterial and venous anastomosis in an end-to-end fashion using 9-0 nylon suture with a running suture technique. The epigastric and internal mammary vessels are immobilized in double aneurysm clips and set on top of a cottonoid to permit accurate suture placement (Fig. 9). Use of the double aneurysm

Figure 9 The venous microanastomosis set-up: the internal mammary and deep inferior epigastric vessels are immobilized in a double aneurysm clip; a running anastomosis is performed.

clips and running suture technique result in relatively short flap ischemic times, ranging from 16 to 24 minutes. Coupling devices may be used; we have not found that they reduce flap ischemia time.

Following the vessel anastomosis, a microneurorrhaphy is performed between the anterior (medial) or lateral branch of the fourth intercostal nerve and either the 10th or 11th intercostal nerve branch to the TRAM or DIEP flap. Previous abdominal surgery may preclude the inclusion of an intercostal nerve with the flap. The neurorrhaphy is performed in one of two ways: an epineurial repair with interrupted 9-0 nylon or nerve intubation using discarded segments of epigastric artery or vein (Fig. 10).

Shaping and inseting of the flap and closure of the donor site are performed simultaneously. The muscle-sparing TRAM and DIEP flaps obviate the need for mesh in the donor site fascial closure.

Microvascular free gluteal perforator flap reconstruction is considered when the free TRAM/DIEP, or latissimus dorsi myocutaneous flap, is not an option.^{49,50} Either the inferior gluteal artery perforator (IGAP) or superior gluteal artery perforator (SGAP) flaps are used, depending on the configuration of the gluteal soft tissues. The IGAP flap will be selected if the patient has a ptotic, lenticular area of soft tissue in the lower gluteal area; the SGAP flap will be used if there is a sufficient amount of pliable soft tissue in the upper buttock.

Figure 10 The microneurorrhaphy between the anterior branch of the fourth intercostal nerve and 11th intercostal branch of a DIEP flap; an nerve intubation technique using an arterial segment is shown.

Anesthesia Considerations

The anesthesiologist plays an important role in flap reconstructions, particularly in microvascular free TRAM/DIEP and gluteal flap procedures. Administration of paralytic agents (for example, pancuronium, vecuronium, or rocuronium), singly or in sequenced combinations, during the flap harvest keeps the muscle portion of the flap quiet, allowing for safe dissection of the perforators. Often the doses of these agents are higher, sometimes much higher, than those required to maintain general paralysis. The patient is kept warm: the room is made warm (76 to 78°F) prior to patient entry (it may be cooled once these additional measures are implemented and if patient temperature remains stable); the patient is placed on a warming pad and covered with a warm-air device (such as a Bair Hugger); a heated circuit or humidivent is employed; warm fluids are administered. Using these methods we can routinely keep the patient temperature at or near 37°C. The key to achieving this goal is not getting behind; hypothermia is difficult to correct. The anesthesiologist maintains systolic blood pressure between 100 and 120 mm Hg following flap anastomosis; however, vasoconstricting drugs must not be used as they may precipitate vasospasm of the flap microcirculation, flap pedicle, or recipient vessels. Generous administration of intravenous fluids avoids hypotension as well as cutaneous vasospasm in the flap. For unilateral free TRAM or DIEP flap procedures, patients typically receive 4500 to 5000 mL of crystalloid; for bilateral reconstructions the level increases to 6000 to 6500 mL. A deep extubation is accomplished prior to departure from the operating room. Adequate administration of narcotics during the procedure establishes and maintains patient comfort and minimizes blood pressure fluctuations in the recovery room. The anesthesiologist prevents nausea and vomiting with multiple agents, usually combining two or more agents having different mechanisms of action.

Operative Techniques: Latissimus Dorsi Myocutaneous Flap

We use the Latissimus dorsi myocutaneous flap in cases in which the patient is not a good candidate for a microsurgical free tissue transfer procedure: a history of multiple abdominal procedures with multiple scars; a large panniculus with indurated, poorly perfused soft tissue; insufficient gluteal soft tissue; overly dense gluteal soft tissue (which makes shaping and inseting of the flap difficult); and in cases in which there is a combination of medical conditions such as diabetes mellitus, morbid obesity, and/or smoking, and an unfavorable abdominal scar, for example in the right subcostal area.^{51,52}

The Latissimus dorsi flap is also utilized as a second flap following initial reconstruction with a free TRAM or DIEP flap if the initial flap does not provide

enough soft tissue to adequately reconstruct the breast and chest wall. We have found the addition of the latissimus dorsi flap to be useful for delayed breast reconstructions in which the chest wall has been irradiated; the flap can be added at a second stage, placing it in the upper pole-chest wall regions to replace tissues with cicatricial scarring and radiation dermatitis.

In our experience, closure of the donor site with underlying quilting sutures, lining the donor site with fibrillar collagen and fibrin glue, and placement of multiple drains decreases the incidence of seroma formation.

Operative Techniques: Tissue Expander Implant Reconstruction

Tissue expander implant breast reconstructions are performed in patients who choose this option over autologous methods, in patients who are not candidates for an autogenous tissue method of reconstruction, in those patients who do not wish to encumber the morbidity of a flap donor site, or in patients having a combination of these factors. In our practice it is rare that we encounter a patient who is not a candidate for some type of autogenous tissue reconstruction. This reflects our practice philosophy, with its admitted bias toward autogenous tissue. It also reflects the realities encountered in breast reconstruction: a thin soft tissue envelope; areas of poorly perfused soft tissue, which may progress to full-thickness loss; a mastectomy that extends beyond the true boundaries of the breast; and loss of upper and lateral chest wall soft tissues. Tissue expander reconstruction is difficult to accomplish when any one, and especially more than one, of these postmastectomy defects is present.

When we perform a tissue expander implant reconstruction, a standard protocol is followed: complete submuscular placement of the tissue expander via a muscle-splitting incision, if possible; irrigation of implant and subpectoral pocket with a multiple antibiotic solution; initial filling of the expander 3 to 4 weeks after placement; and use of an upper chest compression garment to prevent upward migration of the expander.

Depending on patient circumstances, either a saline-filled or gel-filled prosthesis is placed following adequate tissue expansion.

POSTOPERATIVE CARE

Hospital Setting

Clinical pathways have been developed to streamline postoperative care and to minimize resource costs. Following surgery patients are taken to the postanesthesia recovery room; we do not admit patients to the surgical intensive care unit. The recovery room nurses have been trained to monitor both free and pedicled flaps. Flap monitoring is accomplished by evaluating skin paddle

color, capillary refill, and arterial or venous Doppler signals using a pencil probe. The nurses assess the flap for a hematoma or unusual swelling. Recovery room and floor nursing staff follow a set of preprinted postoperative orders.

Patients are transferred to a surgical floor where routine flap monitoring and postoperative care is administered. We have implemented postoperative protocols for flap monitoring, patient mobilization, and advancement of diet. A low-dose heparin drip (300 U/h) is maintained for 24 hours. Starting on the first postoperative day the patient receives one baby aspirin (81 mg) per day; the aspirin is discontinued at the end of 1 week.

Surgical nurses have been trained to recognize venous outflow obstruction, occlusion of arterial inflow, and flap hematoma. The nursing staff has been instructed to promptly notify the surgeon on call if one of the above complications is observed. If the surgeon confirms that the complication has indeed occurred, the patient is taken to the operating room emergently for flap exploration and correction of the problem.

The typical hospital stay is 3 to 4 days following the day of surgery. Preoperatively, patients are given information packets containing detailed instructions for the postoperative period. These information packets are accompanied by teaching by our practice nursing staff. Discharge instructions are reiterated to the patient by the hospital nursing staff on the day of hospital discharge. Patient education is an ongoing process; adherence to postoperative clinical pathways minimizes the length of hospital stay, decreases overall recovery time, and improves patient comfort.

Office Setting

Postoperative follow-up in the office setting proceeds according to clinical pathways that describe a gradual increase in activity, timing of drain removal, care of incisions, discontinuation of aspirin and pain medications, wearing of postoperative garments, and criteria for returning the patient to work.

TREATMENT OF COMPLICATIONS

Early complications include: acute occlusion of flap inflow or outflow at the level of the pedicle; "intraflap" outflow occlusion secondary to venous perforator insufficiency; loss of native breast skin (Fig. 11); hemorrhage or hematoma formation of the donor site, flap, or chest wall sites; donor site wound-healing problems (Fig. 12); deep vein thrombosis and pulmonary embolus; atelectasis; ileus; and donor or recipient site infection. Arterial and venous occlusions are rare, occurring in ~0.5% of our microvascular free flap patients from 1996 to 2003; the total flap loss rate was 0.9% for 2002 to 2003. As we

Figure 11 A unilateral muscle-sparing free TRAM flap reconstruction complicated by necrosis of the native breast skin. (A) Preoperative view. (B) Postoperative view depicting native skin loss. (C, D) Long-term postoperative results following TRAM flap and native skin revision and nipple-areola reconstruction.

have made the shift toward extreme muscle sparing free TRAM and DIEP flaps, we have encountered, in 2003, two cases of venous outflow obstruction secondary to insufficient venous perforator anatomy; flap congestion progressed to necrosis despite a patent venous anastomosis and flap recipient venous pedicle. We address minor loss of the native breast skin with local wound care. In some cases formal debridement and closure via local tissue advancement is performed. Patients in whom a hematoma is suspected are promptly explored. Small donor site wound-healing problems are treated with local wound care. More extensive donor site wounds are treated with a vacuum-assisted closure device with or without subsequent secondary closure. Use of elastic stockings, venous compression devices, and early mobilization have made deep vein thrombosis and pulmonary embolus extremely rare occurrences. Similarly, clinically significant atelectasis is rare because of early mobilization and encouragement of incentive spirometry. Ileus,

occasionally occurring in the setting of an obese patient with a barrel-shaped truncal deformity undergoing bilateral free TRAM flap reconstruction, is treated with nasogastric tube aspiration and dietary restriction until bowel function resumes. Donor and recipient site infections usually consist of cellulitis and are treated with the appropriate antibiotics; an abscess is treated with incision and drainage.

Late complications include: fat necrosis, partial flap loss, and abdominal wall laxity (hernia formation). Areas of fat necrosis can be directly excised or broken up with liposuction. Partial flap loss is a difficult problem. Small losses may be corrected with dermal (fat grafts, Alloderm, and fat) injections; larger losses may require a second flap. We repair abdominal wall defects in which there has been dehiscence of the anterior rectus sheath and underlying layers with an internal oblique musculofascial advancement, or separation of parts, technique.⁵³

Figure 12 Partial dehiscence of a free TRAM donor site.

SECONDARY PROCEDURES

Revision of the reconstructed breast, nipple reconstruction, alteration of the native breast with mastopexy or reduction mammoplasty, ancillary grafting procedures to address residual small flap and chest wall defects, and donor site revision are performed 4 to 6 months after the flap procedure or after the patient has completed chemotherapy and radiation therapy, if these are required. Usually these procedures are grouped together and performed on an outpatient basis; however, if an extensive revision of the reconstructed breast is necessary, the nipple reconstruction may be performed at a later date, usually as an office procedure. Creation of the areola with a tattooing system follows 2 to 3 months later, completing the breast reconstruction.

PRACTICE DATA

We have collected data from our free TRAM and DIEP flaps procedures from 1996 to 2003. A total of 908 free TRAM and/or DIEP flaps have been performed in 743 consecutive patients. Operative times, length of hospital stay, flap ischemia (vessel preparation and microsurgical anastomosis) times, and morbidity have been compared for three groups of patients. Data were compared for three 1-year periods (1996, 1999, and 2002) during which times technical and clinical improvements were made. Groups were compared using a two-tailed *t* test to determine statistical differences set a $P < 0.05$. Data are presented as mean $\pm$ standard deviation.

For 1996, 48 free TRAM flap procedures were performed in 34 patients. During period two, 106 free TRAM flaps were performed in 87 patients; clinical and intraoperative pathways were initiated in this time period. Further refinements in the surgical and clinical pathways were made during time period for group three; 157 free TRAM flaps were performed in 117 patients in this group. In 2003, we performed 208 free muscle-sparing and/or DIEP flaps in 157 patients. The incidence of diabetes mellitus, smoking, obesity, and morbid obesity were not statistically different between the groups.

Operative times were reduced from 6.7 ± 0.4 hours for group 1 to 4.9 ± 0.4 hours for group 2 to 3.25 ± 0.7 hours for group 3 (Fig. 13). Corresponding decreases in flap ischemia times were achieved: from 49 ± 6 minutes (group 1) to 33 ± 5 minutes (group 2) to 24 ± 4 minutes (group 3); Fig. 14). Complication rates were not statistically different between groups: 23% (group 1), 17% (group 2), and 18% (group 3). Flap loss

Figure 13 Decreases in reconstructive operative times follows implementation of surgical and operating room clinical pathways.

Figure 14 Decreases in flap ischemia times for three groups: 1996, 1999, and 2002.

rates were not statistically different: 0% (group 1), 0.9% (group 2), and 1.3% (group 3). Hospital stay decreased from 4.2 days (group 1) to 3.4 days (group 2; $P < 0.05$), remaining constant thereafter in group 3 at 3.7 days.

Developing and standardizing intraoperative maneuvers and pre- and postoperative clinical pathways can reduce total operative times, microsurgical times, and lengths of hospital stay. Tebbetts has outlined principles designed to improve efficiency and outcomes for breast augmentation; these same principles can be applied to microsurgical procedures.^{54,55} Periodic reassessment of surgical and clinical pathways, with implementation of new ideas, further improves efficiency.

FUTURE TRENDS

The surgeons of our practice have made the shift from a muscle-sparing microvascular free TRAM flap, based on

three to four perforators, including a section of rectus abdominus muscle up to one third the width of the muscle, to the DIEP flap, based on one to three perforators (usually two), including no rectus muscle. We routinely perform a microneurotomy, when possible; we are accruing a series of patients for the year 2003 to assess quality of sensation in the flap skin island.

The role of autogenous tissue breast reconstruction with the free TRAM or DIEP flap continues to expand. In addition to being used for reconstruction following mastectomy for a definitive breast cancer, these and other perforator flaps are being increasingly utilized for breast reconstruction in these settings: reconstruction for partial mastectomy defects, bilateral mastectomy for patients with the *BRCA 1* or *BRCA 2* genes; mastectomy for severe fibrocystic disease with symptoms recalcitrant to dietary and drug therapy (Fig. 15); the congenitally deformed breast; and to

Figure 15 A 28-year-old woman with severe symptomatic fibrocystic disease who underwent nipple-areola-sparing mastectomies and bilateral free DIEP flap reconstruction. (A) Preoperative view. (B) Postoperative view.

correct severe, recurrent contracture and periprosthetic atrophy associated with breast augmentation.

Whether to perform the breast reconstruction as an immediate or delayed procedure in the face of postmastectomy radiation continues to be a sticking point for our practice.⁵⁶ In some cases we have seen severe shrinkage and distortion of the free TRAM/DIEP flap following external beam radiation, requiring excision of the flap and repeat breast-chest wall reconstruction with another autogenous tissue method. Lumpectomy followed by local delivery of radiation via a device such as the Mammosite catheter has recently been introduced as a breast cancer treatment option in our community; this mode of treatment may produce partial breast deformities requiring flap reconstruction.

The passage of state and federal laws mandating coverage for breast reconstruction procedures on the part of insurers has been beneficial to those plastic surgeons in private practice wishing to perform this service. However, rising malpractice premiums and other overhead costs, laborious interactions with insurers, and declining reimbursements have made breast reconstruction more difficult to accomplish in a private practice setting. To maintain breast reconstruction as a significant part of a private practice all members of the practice must strive for efficiency, low complication rates, and a high level of patient satisfaction.^{21,57} Best practices must be developed and periodically reevaluated. The practice should make a commitment to having breast reconstruction be a core component of its services. If the practice can establish itself as a center of excellence in the local community, achieving high patient throughput and consistently good outcomes, it may be able to negotiate more favorable reimbursements with payors. Increasing efficiency and keeping overhead costs as low as possible will make breast reconstruction more tenable financially, regardless of the reimbursement level.

CONCLUSION

In our experience we have found that with practice and institutional efforts, keeping operative times at or below 3 hours for unilateral reconstructions and 5 hours for bilateral cases, limiting hospital stays to 3 to 4 days, and following standardized pre- and postoperative clinical pathways, breast reconstruction can be successfully performed in the private practice setting.

ACKNOWLEDGMENTS

I would like to thank Melissa Babcock and Sharon Lacey Supik for their assistance in the preparation of this manuscript.

REFERENCES

1. Kroll SS. Why autologous tissue? *Clin Plast Surg* 1998;25:135-143
2. Miller MJ. Immediate breast reconstruction. *Clin Plast Surg* 1998;25:145-156
3. Craigie JE, Allen RJ, DellaCroce FJ, Sullivan SK. Autogenous breast reconstruction with the deep inferior epigastric perforator flap. *Clin Plast Surg* 2003;30:359-369
4. Asko-Seljavaara S. Delayed breast reconstruction. *Clin Plast Surg* 1998;25:157-166
5. Schusterman MA. The free TRAM flap. *Clin Plast Surg* 1998;25:191-195
6. Evans GRD, Kroll SS. Choice of technique for reconstruction. *Clin Plast Surg* 1998;25:311-316
7. Wanzel KR, Brown MH, Anastakis DJ, Regehr G. Reconstructive breast surgery: referring physician knowledge and learning needs. *Plast Reconstr Surg* 2002;110:1441-1450
8. Reaby L. Reasons why women who have mastectomy decide to have or not to have breast reconstruction. *Plast Reconstr Surg* 1998;101:1810-1818
9. Alderman AK, Wilkins EG, Lowery JC, et al. Determinants of patient satisfaction in postmastectomy breast reconstruction. *Plast Reconstr Surg* 2000;106:769-776
10. Reece GP, Kroll SS. Abdominal wall complications: prevention and treatment. *Clin Plast Surg* 1998;25:235-249
11. Nahabedian MY, Momen B, Galdino G, Manson PN. Breast reconstruction with the free TRAM or DIEP flap: patient selection, choice of flap, and outcome. *Plast Reconstr Surg* 2002;110:466-477
12. Kroll SS. Bilateral breast reconstruction. *Clin Plast Surg* 1998;25:251-259
13. Blondeel PN. One hundred free DIEP flap breast reconstructions: a personal experience. *Br J Plast Surg* 1999;52:104-111
14. Wei FC, Suominen MD, Cheng MH, et al. Anterolateral thigh flap for postmastectomy breast reconstruction. *Plastic and Reconstructive Surgery* 2002;110:82-88
15. Karanas YL, Santoro TD, Da Lio AL, Shaw WW. Free TRAM flap breast reconstruction after abdominal liposuction. *Plast Reconstr Surg* 2003;112:1851-1855
16. Schusterman MA. Bilateral breast reconstruction in very thin patients with extended free TRAM flaps. *British Journal of Plastic Surgery* 1998;51:191-195
17. Schusterman MA, Kroll SS, Weldon ME. Immediate breast reconstruction: why the free TRAM over the conventional TRAM flap? *Plast Reconstr Surg* 1992;90:255-261
18. Langstein HN, Cheng MH, Singletary E, et al. Breast cancer recurrence after immediate reconstruction: patterns and significance. *Plast Reconstr Surg* 2003;111:712-720
19. Polednak A. Geographic variation in postmastectomy breast reconstruction rates. *Plast Reconstr Surg* 2000;106:298-301
20. Alderman AK, McMahon L Jr, Wilkins EG. The national utilization of immediate and early delayed breast reconstruction and the effect of sociodemographic factors. *Plast Reconstr Surg* 2003;111:695-703
21. Collins ED. Discussion, reconstructive breast surgery: referring physician knowledge and learning needs. *Plast Reconstr Surg* 2002;110:1451-1454
22. Chang DW, Wang B, Robb GL, et al. Effect of obesity on flap and donor-site complications in free transverse rectus abdominus myocutaneous flap breast reconstruction. *Plast Reconstr Surg* 2002;109:1199-1200

23. Chang DW, Reece GP, Wang BG, et al. Effect of smoking complications in patients undergoing free TRAM flap breast reconstruction. *Plast Reconstr Surg* 2002;110:2374-2380
24. Spear SL, Majidian A. Immediate breast reconstruction in two stages using textured, integrated-valve tissue expanders and breast implants: a retrospective review of 171 consecutive breast reconstructions from 1989 to 1996. *Plast Reconstr Surg* 1998;101:53-63
25. Allen RJ, Treece P. Deep inferior epigastric perforator flap for breast reconstruction. *Ann Plast Surg* 1994;32:32-38
26. Hamdi M, Weiler-Mithoff EM, Webster MH. Deep inferior epigastric perforator flap in breast reconstruction: experience with the first 50 flaps. *Plast Reconstr Surg* 1999;103:86-95
27. Blondeel PN, Boeckx WD. Refinements in free flap breast reconstruction: the free bilateral deep inferior epigastric perforator flap anastomosed to the internal mammary artery. *Br J Plast Surg* 1994;47:495-501
28. Blondeel PN, De Muynck M, Mete D, et al. Sensate nerve repair in perforator flaps for autologous breast reconstruction: sensational or senseless? *Br J Plast Surg* 1999;52:37-44
29. Nahabedian MY, Tsangaris T, Momen B, Manson PN. Infectious complications following breast reconstruction with expanders and implants. *Plast Reconstr Surg* 2003;112:467-476
30. Kroll SS, Evans GRD, Reece GP, et al. Comparison of resource costs between implant-based and TRAM flap breast reconstruction. *Plast Reconstr Surg* 1996;97:364-372
31. Miller SH. Comparison of costs between implant-based and TRAM flap breast reconstruction. *Plast Reconstr Surg* 1996;98:916-917
32. Spear SL, Mardini S, Ganz JC. Resource cost comparison of implant-based breast reconstruction versus TRAM flap breast reconstruction. *Plast Reconstr Surg* 2003;112:101-105
33. Blondeel PN, Vanderstraeten GG, Monstrey SJ, et al. The donor site morbidity of free DIEP flaps and free TRAM flaps for breast reconstruction. *Br J Plast Surg* 1997;50:322-330
34. Nahabedian MY, Manson PN. Contour abnormalities of the abdomen after transverse rectus abdominis muscle flap breast reconstruction: a multifactorial analysis. *Plast Reconstr Surg* 2002;109:81-87
35. Blondeel PN. Discussion: contour abnormalities of the abdomen after transverse rectus abdominis muscle flap breast reconstruction: a multifactorial analysis. *Plast Reconstr Surg* 2002;109:88-90
36. Nahabedian MD, Dooley W, Singh N, Manson PN. Contour abnormalities of the abdomen after breast reconstruction with abdominal flaps: the role of muscle preservation. *Plast Reconstr Surg* 2002;109:91-101
37. Kroll SS, Schusterman MA, Reece GP, et al. Abdominal wall strength, bulging, and hernia formation after TRAM flap breast reconstruction. *Plast Reconstr Surg* 1995;96:616-619
38. Ninkovic MM, Schwabegger AH, Anderl H. Internal mammary vessels as a recipient site. *Clin Plast Surg* 1998;25:213-221
39. Clark CP III, Rohrich RJ, Copit S, et al. An anatomic study of the internal mammary veins: clinical implications for free-tissue-transfer breast reconstruction. *Plast Reconstr Surg* 1997;99:400-404
40. Feng LJ. Recipient vessels in free-flap breast reconstruction: a study of the internal mammary and thoracodorsal vessels. *Plast Reconstr Surg* 1997;99:405-416
41. Mehrara BJ, Santoro T, Smith A, et al. Alternative venous outflow vessels in microvascular breast reconstruction. *Plast Reconstr Surg* 2003;112:448-455
42. Robb GL. Thoracodorsal vessels as a recipient site. *Clin Plast Surg* 1998;25:207-211
43. Hallock GG. Doppler sonography and color duplex imaging for planning a perforator flap. *Clin Plast Surg* 2003;30:347-357
44. Vandevoort M, Vranckx JJ, Fabre G. Perforator topography of the deep inferior epigastric perforator flap in 100 cases of breast reconstruction. *Plast Reconstr Surg* 2002;109:1912-1918
45. El-Mrakby HH, Milner RH. The vascular anatomy of the lower anterior abdominal wall: a microdissection study on the deep inferior epigastric vessels and the perforator branches. *Plast Reconstr Surg* 2002;109:539-543
46. Blondeel PN, Van Landuyt K, Monstrey SJM, et al. The "Gent" consensus on perforator flap terminology: preliminary definitions. *Plast Reconstr Surg* 2003;112:1378-1382
47. Blondeel PN, Arnstein M, Verstraete K, et al. Venous congestion and blood flow in free transverse rectus abdominis myocutaneous and deep inferior epigastric perforator flaps. *Plast Reconstr Surg* 2000;106:1295-1299
48. Kroll SS. Fat necrosis in free transverse rectus abdominis myocutaneous and deep inferior epigastric perforator flaps. *Plast Reconstr Surg* 2000;106:576-583
49. Allen RJ. The superior gluteal artery perforator flap. *Clin Plast Surg* 1998;25:293-302
50. Blondeel PN, Van Landuyt K, Hamdi M, Monstrey SJ. Soft tissue reconstruction with the superior gluteal artery perforator flap. *Clin Plast Surg* 2003;30:371-382
51. Papp C, McCraw JB. Autogenous latissimus breast reconstruction. *Clin Plast Surg* 1998;25:261-266
52. Delay E, Gounot N, Bouillot A, et al. Autologous latissimus breast reconstruction: a 3-year clinical experience with 100 patients. *Plast Reconstr Surg* 1998;102:1461-1478
53. Kroll SS, Schusterman MA, Mistry D. The internal oblique repair of abdominal bulges secondary to TRAM flap breast reconstruction. *Plast Reconstr Surg* 1995;96:100-104
54. Tebbetts JB. Achieving a predictable 24-hour return to normal activities after breast augmentation: part I. Refining practices by using motion and time study principles. *Plast Reconstr Surg* 2002;109:273-290
55. Tebbetts JB. Achieving a predictable 24-hour return to normal activities after breast augmentation: part II. Patient preparation, refined surgical techniques, and instrumentation. *Plast Reconstr Surg* 2002;109:293-305
56. Rogers N, Allen RJ. Radiation effects on breast reconstruction with the deep inferior epigastric perforator flap. *Plast Reconstr Surg* 2002;109:1919-1924
57. Heinz TR, Cowper PA, Levin LS. Microsurgery costs and outcome. *Plast Reconstr Surg* 1999;104:89-96